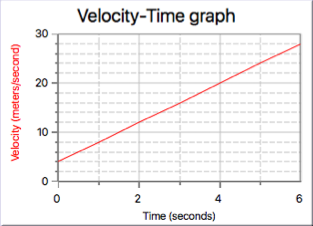
**Unit 3 – Activity 2**

**Determining Displacement for a Non-Constant Velocity**

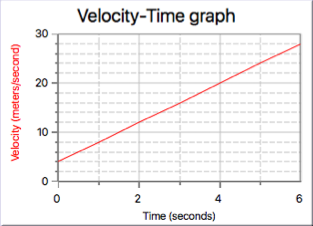
In the past, we have found the displacement for an object moving by finding the area under the velocity versus time graph. In Unit 2, that area was a rectangle, and was therefore easily graphed and easily programmed.

**Will the same methods work for a non-constant velocity versus time graph?**

First, let’s find the total displacement of the motion using geometry for the full 6 seconds. The shape is a trapezoid, or what we can approximate as a rectangle with a triangle sitting on top.

|  |  |
| --- | --- |
|  |  |
| The area of the rectangle is: | The area of the triangle is: |
| The total area is:  **So the total displacement is:** | |

This method will not work for our programming, so let’s consider the rectangular method we used in Unit 2.



Up to this point, we have been using ‘v’ to determine our displacement for the next step, as illustrated to the left.

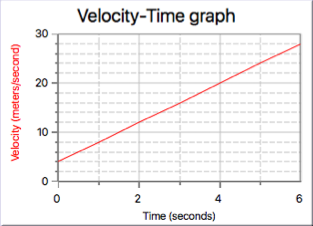
We will now calculate the displacement for the entire motion for the graph we saw on page 1.

|  |  |
| --- | --- |
| Time interval | Area of the velocity-time graph (aka, displacement) |
| 1. sec to 1.0 sec | Rectangle = length \* width  (4 meters/second \* 1 second) = 4 meters |
| 1.0 sec to 2.0 sec |  |
| 2.0 sec to 3.0 sec |  |
| 3.0 sec to 4.0 sec |  |
| 4.0 sec to 5.0 sec |  |
| 5.0 sec to 6.0 sec |  |

**Total displacement = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Using this method:next-x(x) **is** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The previous method produced a displacement *smaller* than expected. So, we will try another method.



This time, we will use the ‘next-v’ value to determine our displacement for the next step, as illustrated to the left.

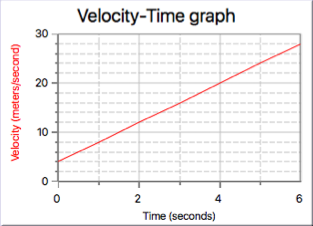
We will now calculate the displacement for the entire motion for the graph as we just did.

|  |  |
| --- | --- |
| Time interval | Area of the velocity-time graph (aka, displacement) |
| 1. sec to 1.0 sec | Rectangle = length \* width  (8 meters/second \* 1 second) = 8 meters |
| 1.0 sec to 2.0 sec |  |
| 2.0 sec to 3.0 sec |  |
| 3.0 sec to 4.0 sec |  |
| 4.0 sec to 5.0 sec |  |
| 5.0 sec to 6.0 sec |  |

**Total displacement = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Using this method:next-x(x) **is** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The previous method produced a displacement *larger* than expected. So, we will try another method.



Recall: In Worksheet 1, we were able to determine the *average velocity.* The average velocity was approximately the same as the velocity at the ‘mid-point’ for the time interval we used.

We will use the midpoint velocity between ‘v’ and ‘next v’ (aka, the average velocity) for that interval, and determine the displacement with that value.

|  |  |
| --- | --- |
| Time interval | Area of the velocity-time graph (aka, displacement) |
| 1. sec to 1.0 sec | Rectangle = length \* width  (6 meters/second \* 1 second) = 6 meters |
| 1.0 sec to 2.0 sec |  |
| 2.0 sec to 3.0 sec |  |
| 3.0 sec to 4.0 sec |  |
| 4.0 sec to 5.0 sec |  |
| 5.0 sec to 6.0 sec |  |

**Total displacement = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Using this method:next-x(x) **is** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_